

III. *The Report of the Committee of the ROYAL SOCIETY appointed to examine some Questions in Gunnery.*

Read Nov. 4.
1742.

DR. *Furin* having proposed * Two Questions in Gunnery to be examined, the SOCIETY was pleased to appoint a Committee for that Purpose.

The Questions were,

1. *Whether all the Powder of the Charge be fired, before the Bullet is sensibly moved from its Place?*
2. *Whether the Distance to which the Bullet is thrown, may not become greater or less, by changing the Form of the Chamber, though the Charge of Powder and all other Circumstances continue unchanged?*

At the Meeting of the Committee it was proposed to divide the First Question into Two Parts.

1. *Whether all the Powder of the Charge be fired?*
2. *Whether all the Powder that is fired, be fired before the Bullet is sensibly moved from its Place?*

As to the First Part of the First Question, the Committee are of Opinion, that all the Powder of the Charge is not fired.

They found their Opinion upon the following Experiments:

Pieces of Paper used for Hangings were laid close together upon the Ground, to the Breadth of Ten Feet, in the Line of a Fowling-piece, between it and a Frame of Ten Feet square, covered over with Paper. Upon pointing the Piece towards the Middle of the

* June 24 1742.

Frame,

Frame, and *discharging* it several times *with* and *without* Ball, some Powder was always collected, but mixed with a great deal of Dirt.

It is however to be observed, that in Two Experiments made the 22d of *July*, near the Artillery-Ground, before the President and some of the Fellows, of the SOCIETY, with a finer sort of Powder, in a Barrel of Three Feet Nine Inches in Length, and Three-fourths of an Inch Bore, with Twelve Penny-weight of Powder the First time, and Twenty-four Penny-weight the Second time, without Ball or Wadding, no Powder could be found scattered on the Paper laid before the Piece, nor sticking to a Board at the Distance of about Ten Feet, against which the Piece was pointed. But when the same Powder was fired in a short Barrel of Five Inches Two-tenths of an Inch in the Chace, either with or without Ball, some Quantity of Powder was always collected.

Other Experiments were afterwards made before the Committee, by firing a Fowling-piece charged with Five Penny-weight of Powder, against a Sheet of whited-brown Paper, at the Distance of Two or Three Yards; the Paper was found pierced with several Hundred Holes, and the Jags of the Paper appeared on the Backside. In a second Trial with Ten Penny-weight, the Paper had more Holes in it. A third Trial was made with Five Penny-weight of Powder and Ball, and then few Holes appeared in the Paper. In a fourth Experiment made with a short Screw-barrel Pistol, with a Charge of One Penny-weight two Grains of Powder and a Ball, several Holes were found in the Paper *.

* That the Paper in these Experiments was pierced by the unfired Powder, appears, because several Grains were found lying behind the Frame, to which the Paper was fixed, and some few stuck in the Paper.

But the Irregularities in this manner of collecting the Powder unfired, giving reason to suspect, that some Powder escaped Sideways, beyond the Paper laid to receive it, it was proposed to have a Machine made, which being close every-where but at the End where the Muzzle of the Piece was to be placed, might thereby hinder the Powder from being dissipated. Such a Machine was contrived by Mr. *Ellicot*, and by him presented to the Committee, being a Frame of Wood in Shape like a truncated quadrangular Pyramid ; at the smaller End was a Board to receive the Shot, and the Four Sides of the Machine were covered with thick Paper strongly pasted together, and so prepared as to prevent its taking Fire. This Machine, supported by Props, was placed upon one of its Angles, the Carriage for fixing the Barrels was placed close to the greater Base, which was left open. The Result of the several Experiments were as follows:

The Three first Experiments were made with a Barrel Eight-tenths of an Inch Diameter of the Bore, and the Length of the Chace Five Inches Two-tenths of an Inch. The Charge each time was Six Penny-weight of Powder without Ball ; the Quantities of Powder collected were respectively, One Penny-weight Nineteen Grains ; One Penny-weight Twenty-one Grains ; and One Penny-weight Twenty Grains.

Three other Experiments were made with the same Piece, and with Twelve Penny-weight Charge, without Ball. The Quantities of Powder collected were Four Penny-weight Eighteen Grains ; Four Penny-weight Two Grains and an half ; and Four Penny-weight Twenty-two Grains.

The next Three Trials were with the same Piece, the Charge Six Penny-weight, with a Ball weighing One Ounce Four Penny-weight, being a Mixture of Lead and Tin, and fitting the Piece exactly.

The Quantities of Powder collected each time were respectively, One Penny-weight Five Grains; One Penny-weight Five Grains; and One Penny-weight Eleven Grains.

The last Three Experiments with the same Piece, were made with a Charge of Twelve Penny-weight, the Weight of the Ball as before; and the Quantities of Powder collected, were found to be One Penny-weight Twelve Grains; One Penny-weight Nine Grains; and One Penny-weight Eight Grains and an half.

The Waddings used in all these and the following Experiments, were of thick Leather cut round, to fit the Bore of the Piece.

The Committee then proceeded to examine what Alteration might arise from a greater *Length of Chace*. The Experiments in this Case were made with a Barrel Three Foot Nine Inches in Length, and Three-fourths of an Inch in the Bore; the Charges of Powder, and Weight of leaden Balls, were as before.

In the First Three Experiments with Six Penny-weight Charge, without Ball, the Quantities of Powder collected were Three Grains; Nine Grains; and Nine Grains, respectively. In the Three next Experiments, with Twelve Penny-weight Charge, without Ball, the Quantities of Powder collected were Thirteen Grains; Nine Grains; and Sixteen Grains and an half. The Three following Experiments were with Six Penny-weight Charge and a Ball. The Powder collected was Two Grains; Three Grains; and Two Grains.

The

The last Experiments were made with Twelve Penny-weight Charge and Ball, as before ; the Quantities of Powder collected from Two Discharges were respectively, Two Grains ; and Four Grains and an half. The Frame being broke, a third Experiment could not be made.

The Powder collected after the several Discharges, was put into separate Boxes ; it seemed much bruised, and mixed with Dirt. Yet several of the Parcels being tried, fired with brisk Explosions ; and some of the Powder collected from the Experiments with the short Barrel, amounting to Six Penny-weight Sixteen Grains, being put into the long Barrel, and fired with Ball, went off with a strong Report ; and the Ball pierced the Deal-board, at the End of the Frame, and penetrated Two Inches deep into an Elm-plank placed to receive the Balls.

Some Gentlemen, present at these Experiments, suspecting that Part of the Powder might escape at the open End of the Frame ; the short Barrel was fired with Twelve Penny-weight of Powder and Ball, as before ; through a very large Funnel, the Quantities found, after Three Discharges, were severally, One Penny-weight Two Grains ; Sixteen Grains ; and Fifteen Grains.

Whereas upon removing the Funnel, and discharging the Piece, as before, One Penny-weight Eleven Grains was collected, agreeably to former Experiments ; it seems that the Funnel had a like Effect as lengthening the Piece.

Some Experiments were also made with the short Barrel, filled up with Lead, so as to leave but Three Inches and Three-fourths of an Inch for the Chace, the Piece
being

being then charged with Twelve Penny-weight of Powder and Ball, as before ; the Surface of the Ball was but Eight-tenths of an Inch within the Mouth of the Piece, and the Powder collected, after Three Discharges, was respectively, Two Penny-weight Two Grains; One Penny-weight Seventeen Grains; and One Penny-weight Eleven Grains.

The Barrel being further filled up, so as to leave but Two Inches Eight-tenths for the Chace, and charged as before, the Ball rising about One-fifth of an Inch beyond the Mouth of the Piece, the Powder collected, after the Discharge, was Two Penny-weight Six Grains. Upon a Second Trial, the Ball being as much within the Mouth, One Penny-weight Sixteen Grains was collected. And at the Third Trial, the Ball being level with the Mouth, Two Penny-weight Six Grains were again found.

The Committee also caused some Experiments to be made of the Effect of a *Touch-hole* near the Fore-part of the Charge. They found upon discharging the short Piece of Five Two-tenths of an Inch Chace, the Charge Twelve Penny-weight and Ball, as before, the Touch-hole being near the Fore-part of the Powder ; the Quantities of Powder, severally collected, were One Penny-weight Seven Grains and an half ; One Penny-weight Six Grains ; and One Penny-weight Four Grains. And upon a Discharge made with a little more Powder, which filled the Barrel exactly to the Edge of another Touch-hole, the former being screwed up, the Quantity collected was One Penny-weight Nine Grains.

The Effect of firing with *heavy Slugs* was also examined : The Weight of the Slugs and Quantities
of

of Powder collected, were as follows; the Charge in the short Barrel being Twelve Penny-weight :

Discharge. Weight of Slugs.			Powder collected.	
	Ounces.	dwt. gr.	dwt.	gr.
I.	2.	13. 0.	1.	3.
II.	2.	11. 14.	0.	17.
III.	2.	12. 0.	0.	8.
IV.	5.	5. 6.	0.	13.
V.	5.	3. 0.	0.	8 $\frac{1}{2}$.

The Powder used in all these Experiments, made before the Committee, was presented to them by Mr. *Walton*, and is such as he makes for the King's Service. To ascertain as nearly as possible, that the Powder had not undergone any considerable Alteration by Damps or otherwise, a Standard Experiment was previously made at every Meeting, with the short Barrel charged with Twelve Penny-weight of Powder, and with a Ball of Twenty-four Penny-weight; and the Quantity of Powder collected was from One Penny-weight Eight Grains, to One Penny-weight Twelve Grains; which is as great a Regularity as can well be expected. This Powder of Mr. *Walton* being *sifted*, and divided into a *fine* and a *large Sort*, the following Discharges were made with Twelve Penny-weight of each, and Ball as usual :

Discharges with fine Powder.		Powder collected.	
		dwt.	gr.
I.	1.	4.
II.	0.	21.
III.	0.	12.

In this Third Experiment the Bullet, not being so exactly turned as the others, was rammed down with great Force.

Dis-

Discharge with large Powder.	Powder collected.	
	dwt.	gr.
I.	1.	11.
II.	1.	16.
III.	1.	21.

And the Powder being bruised in a Mortar, and sifted through a Lawn Sieve, the Charge and Ball being as before, what was collected after Three Discharges, was One Penny-weight Ten Grains, One Penny-weight Eight Grains, and Seventeen Grains.

Mr. *Watson* having had two Parcels of Powder delivered to him, the one fresh, and the other collected after Discharges with Ball, gave an Account of the Quantity of Nitre he had separated from them, *viz.*

Separated from Nine Penny-weight of fresh Powder		} dwt. gr.	
Nitre . . .	6.	2.	
Residuum . . .	2.	7.	
Loss . . .		0.	15.

From Nine Penny-weight of Powder collected after having been discharged with Ball		} dwt. gr.	
Nitre . . .	4.	18.	
Residuum . . .	2.	15.	
Sand, &c. . .	0.	11.	
Loss . . .		1.	14.

Twelve Grains of the Powder gathered and put into separate Boxes, after firing with Ball out of the short Piece, as before-mentioned, being fired in the exhausted Receiver, sunk the Mercurial Gage from Twenty-nine Inches One-tenth to Twenty-three Six-tenths.

tenths. And the same Weight of fresh Powder being fired in the same manner, sunk the Gage to Twenty-two Inches Three-fourths; the Difference being $\frac{85}{100}$ or $\frac{17}{20}$ of an Inch.

From these Experiments the Committee are of Opinion, that the First Part of the First Question, *Whether all the Powder of the Charge be fired?* is sufficiently determined in the *Negative*.

As to the Second Part of the First Question, *Whether all the Powder that is fired, be fired before the Bullet is sensibly moved from its Place?* the Committee are of Opinion, *That the Bullet is sensibly moved from its Place, before all the Powder that is fired, has taken Fire.*

This, indeed, has not been determined by any direct Experiment, but seems a Consequence of the Determination of the First Part of the Question, that the Whole of the Charge is not fired.

For let it be considered, that from the Moment any Part of the Powder within the Barrel takes Fire, the Flame of the Powder already fired is always contiguous to some Part of the Powder as yet unfired; and consequently some Part of this last must be continually taking Fire, so long as any unfired Powder remains within the Barrel; that is, the firing of the Powder cannot be over, till all the unfired Powder is driven out of the Gun: But before any Part, how small soever, of the unfired Powder is driven out of the Gun, the Bullet which lies between the Charge and the Muzzle, must necessarily have been driven out of the Gun. Therefore the firing of the Powder is not over, or all the Powder that is fired, is not fired, till after the Bullet is driven out of the Gun. And con-

consequently the Bullet must be sensibly moved from its Place, before all the Powder that is fired, has taken Fire.

As to the Second Question, *Whether the Distance to which the Bullet is thrown, may not become greater or less, by changing the Form of the Chamber, though the Charge of Powder and all other Circumstances continue unchanged?*

The Committee, are of Opinion, *That the Change of the Form in the Chamber, will produce a Change of the Distance to which the Bullet is thrown.* Their Opinion is grounded upon the following Experiments, in which the *longest Chamber* of equal Capacity drove the Ball farthest.

Three brass Chambers were made, whose Depths were respectively Three Inches; one Inch and half; and Three-fourths of an Inch; so turned as to fit the Chamber of Mr. *Hauksbee's* Mortar; each of these Chambers contained, when full, One Ounce *Troy* of Powder. The Ball was of Brass, weighing Twenty-four Pound Six Ounces and an half *Avoirdupois*, that is, nearly Three hundred Fifty-six Ounces *Troy* *.

The Ball touched the Powder of the Charge in all these Experiments. With the First Chamber of Three Inches deep, the Elevation of the Mortar being Forty-five Degrees, the Ranges at Four different Trials were found to be,

<i>Shot.</i>	<i>Chains.</i>	<i>Links.</i>	
I. . . .	11.	39.	or nearly 752 Feet.
II. . . .	10.	38.	685.
III. . . .	11.	17.	737.
IV. . . .	11.	10.	733.

* Supposing 14 Ounces 11 Penny-weight and 15 Grains and an half *Troy*, equal to 1 Pound *Avoirdupois*.

In the Second of these Experiments, the brass Chamber, not being sufficiently thrust home before the Discharge, was by the Violence of the Powder driven in so, that it could not be got out again without the Help of an iron Screw, and a vast Force applied to iron Wedges. This was doubtless the Cause of the great Irregularity observed in this Case. The mean Distance, collected from the other Three Experiments, is nearly 741 Feet.

Then Three Discharges were made with the Chamber Three-fourths of an Inch deep, with Ball, Powder and Elevation, as before. The Ranges were,

<i>Shot.</i>	<i>Chains.</i>	<i>Links.</i>
I.	7.	6. or 466 Feet nearly.
II.	7.	2. 463.
III.	7.	2. 463.

The mean Distance to which the Ball was thrown in these Three Experiments is 464 Feet.

The Chamber One Inch and an half deep, was also tried; but this not fitting the Mortar so well as the other Two, the Ranges were found to be very irregular, being

<i>Shot.</i>	<i>Chains.</i>	<i>Links.</i>
I.	10.	40. or nearly 686 Feet.
II.	9.	6. 598.
III.	7.	8. 467.

The last Shot, falling so much short, may be ascribed to the Damp, it being late in the Evening when it was fired.

That Moisture greatly weakens the Effect of Powder, is commonly known; and the Committce found by an Experiment, That Powder dried by means of a Phial in *Balneo*, and put warm into the Chamber, threw

threw the Ball twice as far as the same Quantity of Powder taken out of the same Barrel, before it was dried.

IV. *An Account of a Meteor seen near Holkam in Norfolk, Aug. 1741. transmitted to the ROYAL SOCIETY by the Right Hon^{ble} Thomas Lord Lovell, F. R. S.*

Read Nov. 4.
1742.

Thomas Savory, John Walker, and others of Lord Lovell's Ploughmen, being at Plough about the Middle of August 1741. on a fair Day, at Ten o'Clock in the Morning, saw on a Heath about a Quarter of a Mile from them, a Wind like a Whirlwind, come gradually towards them, in a strait Line from East to West. It passed through the Field where they were at Plough, tore up the Stubble in the ploughed Ground, and also the Grass besides the same, for Two Miles in Length, and Thirty Yards in Breadth. When it came to some Closes at the Top of a rising Ground called *Ferrybush-Closes*, Philip Henning, and others, who were houghing Turneps, saw it appear like a great Flash or Ball of Fire. After having seen the Wind come into the Closes, Robert May was in a Cottage where he lives by a Road-side, at the Bottom of the Park, about a Furlong down-hill from the Close, when one of his Children about Six Years old, who was playing at the Door, cried out, That *Ferrybush-Closes* were on Fire; on which he went out to look, but saw no Fire, only a terrible Smoak, and heard such a Noise as Fire makes when a Barn is burning.